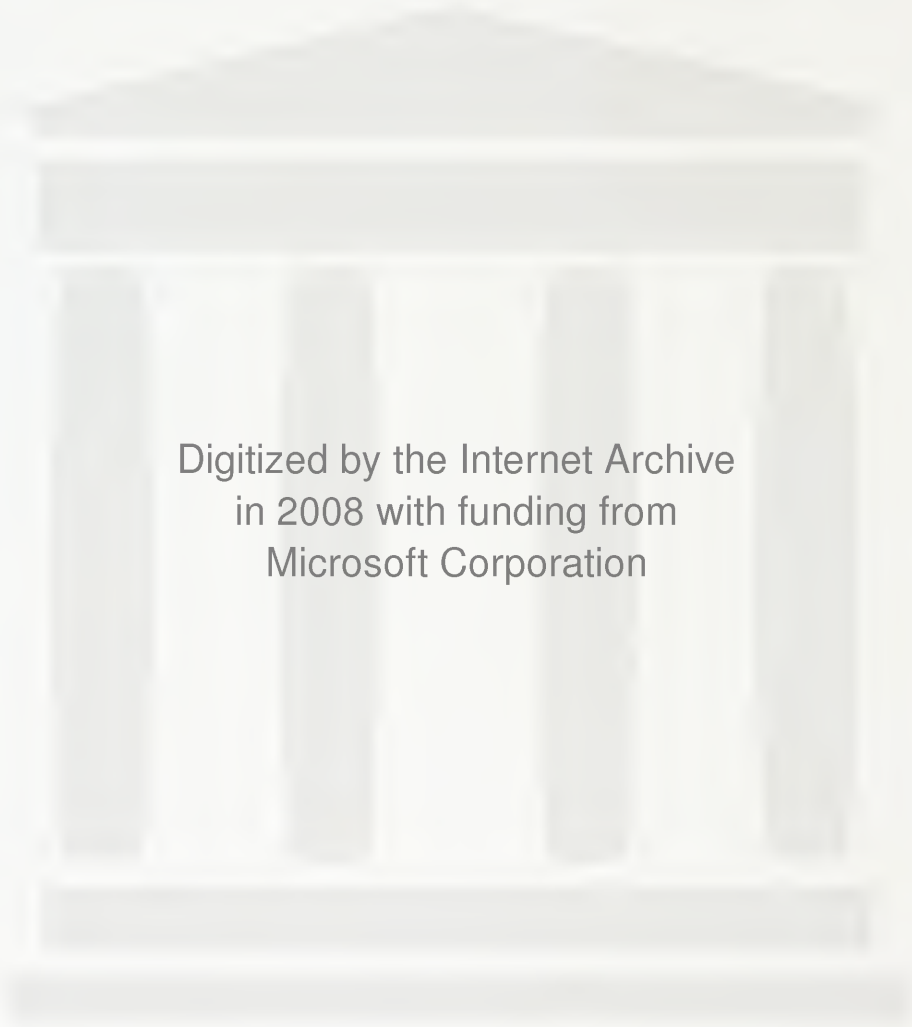
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THE PRINCETON COLLEGE BULLETIN

A QUARTERLY RECORD EDITED BY
THE PRESIDENT AND MEMBERS OF THE FACULTY

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THE NEW CHEMICAL LABORATORY.

Princeton College Bulletin.

EDITED BY THE PRESIDENT AND MEMBERS OF THE FACULTY.

Vol. IV. February, 1892. No. 1.

THE NEW CHEMICAL LABORATORY AT PRINCETON.

At the beginning of the present College year all of the work of the Department of Analytical Chemistry and Mineralogy was transferred from the School of Science building to the new Chemical Laboratory, which has just been erected by the residuary legatees of Mr. John C. Green, to whose liberality the college owes so much.

This fine and convenient building, of which a view is given in this number of the Bulletin, was finished just in time to relieve the crowded condition of the rooms in the School of Science, consequent on the rapid growth of the Scientific Department during the last few years.

The Laboratory has entrances both on Nassau and Washington streets, the main entrance being on Nassau street. It is built in the most substantial manner, after designs by the well-known architect, Mr. Richard M. Hunt, of New York, from plans furnished by Prof. Cornwall. The basement walls are of light-colored sandstone, and the rest of the building is of selected red brick. The construction throughout is of the most approved fireproof style; the walls being furred with hollow brick, all partitions of brick, and the floor beams of iron. The spaces between these beams are filled with brick arches, carrying a solid layer of concrete, on which rest the wood floors. The ceilings in the upper story are of perforated sheet iron suspended from the roof trusses and carrying the plaster. The floor of the basement is of smooth cement and fine flint concrete, except in the halls and the cloak-room, which are tiled. The floors of the upper stories are of yellow pine, and the rest of the wood work, including wainscoting and doors, is of ash.

The Laboratory will accommodate about three times as many students as the one formerly used, and while the plans were made with a view to the most advantageous use of all the room afforded by the site, yet it is believed that few, if any, chemical laboratories allow more space for each student. A more detailed account of the laboratories, lecture-rooms and desks in the building will appear in a future number of the Bulletin, but a brief description of the more important features may here be given. The Nassau street front, which is in the foreground of the view, measures 101 feet 3 inches in length; that on Washington street, shown on the right in the view, 108 feet. The wing on Nassau street is 42 feet wide, and the main wing on Washington street is 58 feet wide. The height of the building is 53 feet. On the top floor are the principal laboratories for students, together with private laboratories for the professors and assistants, balance room, reading room and sulphuretted hydrogen room. The larger of the students' laboratories is 71 feet 10 inches long and 50 feet 2 inches wide, the ceiling being 16 feet high. This laboratory is lighted by a

central skylight 38 feet long and 12 feet wide, besides the numerous windows on both sides and at one end. It is provided with desks for 82 students, each having his own desk with closets and drawers that can be locked. When occasion arises, fourteen more desks can be put in this laboratory. Hoods along both sides furnish facilities for processes requiring the use of strong acids or other reagents likely to cause offensive fumes, and each desk is provided with water, gas and suction for filtering apparatus. The smaller laboratory for students on this floor has forty-two separate desks, also provided with closets and drawers.

On the next floor are two lecture rooms, a mineral cabinet, apparatus rooms, a laboratory for chemical physics, a small laboratory for advanced students, and the professor's private laboratory. The largest lecture room is 50 feet 2 inches long and 38 feet 2 inches wide, and has seats for one hundred and sixty-five students; the smaller lecture room is 34 feet square, with seats for sixty students, and is used by special classes. The ceilings of this story are 15 feet 6 inches high.

In the basement are the janitor's room, large store-rooms, assay laboratory, gas analysis room, and a fine large room which can be used for laboratory experiments in technical chemistry. There is also a very convenient cloak-room, containing 120 lockers, or rather small wardrobes, in which students can hang their hats and overcoats.

In the boiler house near by, which contains the boilers connected with the steam-heating apparatus for a number of the college buildings, is a steam air-pump, which furnishes the suction for the filtering apparatus in the various laboratories.

Especial attention has been paid to securing good light and ventilation, by means of as many windows and flues as the construction of the building would allow.

The efficiency of the department has been greatly increased by the accommodations afforded by this new laboratory, which will also permit the College to offer instruction in experimental and analytical chemistry to many students who could not otherwise have added this branch to their course.

THE HON. SAMUEL WOODRUFF, TRUSTEE OF PRINCETON COLLEGE.

The Hon. Samuel Woodruff, of His Majesty's Council for the province of New Jersey, was a Trustee of Princeton College from its incorporation in the year 1749 until his death in 1768, and during that time he filled no inconsiderable space in its annals. His name appears next after that of President Aaron Burr and before the names of Jonathan Sergeant, Elihu Spencer and Caleb Smith in the committee to negotiate with the inhabitants of Princeton for the site of the College; also in the committee to arrange for the building of Nassau Hall and the President's House; and thereafter in various committees to confer with incoming Presidents, to adjust the relations of the College to the village church, to provide for a due representation of Old and New Side Presbyterians in the Faculty, and generally to take financial measures for replenishing the treasury. As one of the founders and patrons of the College during its early trials, he deserves to be recalled from the obscurity into which he has been thrown by the more brilliant names and events of the Revolutionary era. With the old colonial régime to which he belonged, he seems to have been simply ignored and forgotten by the party since dominant in our history.

Samuel Woodruff was descended from John Woodruff, who left Yorkshire, England, under the disastrous reign of Charles I. and came to the colony of Massachusetts Bay in 1638. Some indications point to

a connection of his family with that of the Earl of Northumberland who took the Presbyterian side in the civil wars.* Be this as it may, it is quite probable that like other gentlemen in the train of Governor Winthrop, he was seeking better fortunes as well as religious freedom in the New England beyond the seas. Finding good land scarce and the Puritan rule as there and then maintained too strict for his conscience and comfort, he withdrew with a like-minded company who sailed out from Lynn in their own vessel, as in another "Mayflower," around Cape Cod, down past the stormy Point Judith, to a well chosen site on the Eastern Shore of Long Island, which they named Southampton, in remembrance of the sea-port whence they embarked for America. Their land-title as derived from the Earl of Stirling having been re-inforced by a humane treaty with the Peconic Indians, this first colony of Englishmen on New York soil became founded in natural as well as legal justice. It was not long before it appeared how they had differed from their Massachusetts brethren on the question of letting the tares and wheat grow together until the judgment. They did not require every townsman to be a church member,—so displeasing their much-loved pastor, the Rev. Abraham Pierson, by their liberal terms of citizenship that he departed from them to join the straiter sect of New Haven. With continued consistency, they afterwards exchanged the Congregational for the Presbyterian type of English Puritanism by connecting themselves with the distant Presbytery of Philadelphia; and at the same time their kinsmen at Elizabethtown readily united under that Presbytery with the Scottish Covenanters who had been fleeing into East Jersey from the persecution of James II. It was thus that the seeds were sown of that form of religious culture which now has its flower in the catholic orthodoxy of Princeton University.†

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* The question is more curious than important. It is known that the same political troubles which drove some of the Yorkshire gentry to New England about the year 1638 soon afterwards impelled the great Presbyterian Earl of Northumberland, and his party in the Long Parliament, to seek for a New England home. (Winthrop's Journal, II, 7, 31, 74. Bancroft's Hist. U. S., I, 383–385. 411–12. Neal's Puritans, 621–2. Histories of Clarendon, Hallam, Von Ranke, Green.) It is also known that Lady Elizabeth Percy, elder sister and co-heiress of the preceding Earl had been married to Richard Woodruffe, of Wooley, in the county of York, and that their grandson Charles Woodruffe, dying shortly before John Woodruff emigrated to America, was succeeded by no legal representatives in England. The line broken in the old world must be traced in the new. —Notes and Queries, Fifth Series, Vol. VIII, 89, 236. Sixth Series, Vol. VII, 127, 396. Seventh Series, Vol. VII, 208, 292, 433.

† The above historical statements are supported by the following authorities: Winthrop's Journal, 204; Mather's Magnalia, III, p. 359; Hutchinson's Hist. of Mass., I, 19, 88; Lechford's News from New England, A. D. 1639; Bradford's New England Chronology, p. 51; Adams' Hist. of New England, pp. 53, 75; Bancroft's Hist. of U. S., Vol. I, pp. 355, 406, 463; Vol. II, 410–13; Palfrey's Hist. of New England, I, pp. 345, 347, 604; II, p. 596; Trumbull's Hist. of Conn., I, pp. 143, 144; Thompson's Hist. of Long Island, I, p. 536; Prime's Hist. of Churches on L. I; Sprague's Annals of Amer. Pulpit, I, p. 116; Addresses at Centennial Celebration at Southampton, L. I.; Briggs' American Presbyterianism, 177, 178; Stearns' Historical Discourses, First Church, Newark, pp. 13, 15; Hatfield's Hist. of Elizabethtown; Hodge's Hist of Presbyterian Church, pp. 35, 37, 55, 56; Whitehead's East Jersey, pp. 58, 59, 138, 238.

East Jersey became an asylum for fugitives from New England intolerance as well as Old England oppression, thus receiving not only Puritans but Covenanters, Hollanders and Huguenots, with strong affinities for Presbyterianism and Episcopacy rather than Congregationalism. All these elements entered into the making of Princeton College, as the roll of trustees during the colonial period shows in such *New England* names as Belcher, Pemberton, Dickinson, Burr, Pierson, Sergeant, Woodruff, Spencer, Caleb Smith, Treat, Brainerd, Ogden, Green, Hazard, Edwards, Cowell; in such *Scotch* names as Hamilton, Livingston, Hude, Johnston, Tennent, Blair, Finley, McKnight, Cumming, Rodgers, Bostwick, Beatty, Kirkpatrick, Ewing, McWhorter, Arthur, Robert Smith, Boyd, Caldwell; and in such *Dutch* and *French* names as Leydt, Frelinghuysen, De Ronde, Boudinot, Bayard, Van Arsdale. To these should be added the *English* names of Leonard, Stockton, Kinsey, Shippen, Redman, some of whom had passed from the Society of Friends into the Presbyterian Church: and the *Welsh* names of Johnes, Davies and Snowden, who had received Presbyterian training. The Episcopalian element also was occasionally represented in the Trusteeship. The first charter had been procured by an enlightened churchman, John Hamilton, Esq., acting Governor of the province. The second charter, as drawn by Gov. Belcher, included among the corporators members of the King's Council who were Episcopalians, and without whose consent no charter would have been granted. The first treasurer of the college was also treasurer of the province, the Hon. Andrew Johnston, a liberal-minded Episcopalian. The Bishop of Durham contributed to the funds, and urged that the college should have the countenance of the Archbishop of Canterbury. In fact, it was largely aided by means of benefactions obtained through the influence of the Countess of Huntingdon, from churchmen, as well as dissenters in Great Britain and Ireland.—See Life and Times of Lady Huntingdon, Vol. I, pp. 140–2. Tyerman's Life of Whitefield, Vol. II, pp 255–6. Belcher Papers, N. J. Archives, VIII, pp. 84, 85; VI, p. 213. MS. Diary of Davies. President Green's Notes, pp. 338, 304, 272, 288. Sprague's Annals, Vol. V. (Episcop.), p. 103. Webster's Hist. of Pres. Church, pp. 258–60, 555, 556.

John Woodruff died at Southampton in 1670. Of his life there little has been learned, but that little bears upon the present inquiry. His daughter Anne Woodruff had been married to Robert Wooley, one of the planters of Elizabethtown; another daughter, Elizabeth, had become the wife of Ralph (or Richard) Dayton, also of an Elizabethtown family; and concerning his son his will, dated May 4, 1670, has the following mention: "I give unto my Eldest son John Woodruff of Elizabeth Town one half Crowne piece of Money in full of all portions and Patrimony whatsoever, to be expected from me, or out of any part of my Estate." Events explain this legal provision to mean that John Woodruff, Jr., had already received his portion and patrimony on leaving Southampton for his new home in the Jersey wilderness. He brought with him his young wife Mary, two menservants and a maid-servant, and acquired a homestead and outlying plantations amounting to more than a thousand acres, still known as Woodruff's Farms. Next to Governor Carteret he appears as the largest landholder of the township. In the little growing settlement of sixty families he took the leading parts of military ensign, constable, High Sheriff, and at length Judge of the Common Pleas, when such offices meant more than they could now. All his children were born in Elizabethtown.* His eldest son probably was John Woodruff the Third, a Burgess in the Colonial legislature, whose wife is still commemorated in the churchyard by an ancient gravestone bearing the conventional skull and hour-glass with this inscription:

Here Lyeth y^e
Body of M^rs. Sarah
Woodruff. Wife
of John Woodruff,
Who departed this
Life 2 of June 1727
in y^e 62^d Year of her Age.

Another son of the planter was Joseph Woodruff, who figured as defendant in a famous test suit of the heirs of Sir George Carteret, which involved the tenure of much Elizabethtown property and, after long pending in the Provincial Council before it could be appealed to the English Court, was at length summarily settled by the American Revolution. His son, Joseph Woodruff the Second, was a distinguished elder of the church, whose Christian graces are rehearsed on a somewhat ornate tombstone in the following terms:

Here is interred what was
Mortal of Mr. Joseph
Woodruff who Died Septem^r
y^e 25^th 1746 in y^e 72 year
of his Age.

Under these clods in dust and ruin lye
Remains of Meekness, Kindness, Piety,
To be revived when Christ in Glory comes
To raise his Saints and call them home.

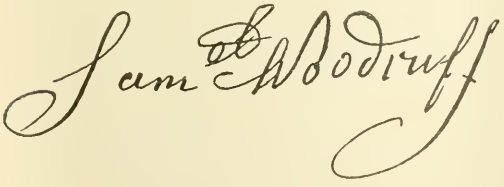
The son of this Joseph and grandson of the first ancestor is the subject of the present sketch.

The information which has been gathered in reference to Samuel Woodruff, though scanty, is exact and significant.†

* From this ancestor are descended the Woodruffs of New Jersey as distinguished from those of Connecticut and New York. They have been a religious race, baptized with Scripture names, and old Elizabethtown surnames in endless complexity of kinship. To the Revolutionary army they contributed more than thirty persons, including nine commissioned officers, and have since risen to distinction in various branches of the public service. In the college they have been well represented throughout its history, by such graduates as Rev. Benjamin Woodruff, son of the Trustee; Hon. George Whitefield Woodruff, Attorney-General of Georgia; Hon. Aaron Dickinson Woodruff, Attorney General of New Jersey; Lieut. Abner Woodruff, U. S. N.; and others of later date. The first known bequest to the college came from Charles Woodruff by his Will, proved April 19, 1751, with Aaron Burr as witness: "I give and bequeath fifteen pounds in current money of this province to the Trustees of the New Jersey College, for the use of the said college, and for no other use whatsoever." The codicil affords a glimpse of emancipation a hundred and forty years ago: "I give my negro man, Cæsar, his freedom, upon condition that he can get any body to be his security according to law."—State Records at Trenton.

† Besides consulting the New Jersey Archives and other publications of the Historical Society; the Standard Histories of N. J., by Smith, Whitehead & Mulford; of Elizabethtown, by Murray and Hatfield; of the College, by Presidents Green and Maclean; of Princeton and its Institutions, by Hageman—the writer has had access to public records and legal documents through the kindness of the Hon. Thomas N. McCarter, John B. Dusenbury, Esq., Surrogate of Essex Co.; Alexander H. Rickey, Assistant Sec'y of State, and Adj.-Gen. William S. Stryker. He is

It will be no difficult exercise of the historic faculty to reconstruct his social environment and estimate his private character and public services. Born in 1700 and dying in 1768 he lived through the most formative period of the College and the country. At a time when Elizabethtown was still the capital of the Jerseys and shared largely in the foreign commerce of New York, he became an eminent merchant, with his ships sailing to the West Indies and to Europe. "Mr. Woodruff," says the chronicler, "having a vessel going to Madeira, Gov. Belcher desires him to import for his use three pipes of Madeira wine and a quarter-cask of Malmsey."* Whatever might now be thought of such an invoice, he acquired both wealth and influence in a community which measured character by religious standards. For many years he was president of the church trustees, as well as a leading elder in the synod during the Old and New Side controversy. His hospitable mansion became a home for the ministers of his day, among whom were the accomplished Pemberton, the learned Dickinson, the zealous Tennents and the eloquent Whitefield. "On the 8th of November, 1749," writes Hatfield, the historian of Elizabethtown, "Elihu Spencer visited his kinsman John Brainerd and found him enjoying the hospitality of Mr. Samuel Woodruff. Two or three days they spent very lovingly together." The Brainerds were entertained by him only less often than by Justice Stockton at Princeton. In other relations of life his townsmen and friends represented the best elements in the colony. John Van Brugh Livingston, of the Livingston Manor, a graduate of Yale College, and an influential merchant who had retired from New York to Elizabethtown, sat with him in the King's Council as well as in the Trusteeship of the College. William Peartree Smith, another Yale graduate and an accomplished scholar and distinguished civilian, shared the same public offices and became connected with him by family ties.† Among his younger associates was Elias Boudinot, destined to become President of the first Congress, an author and a philanthropist; also that scholar and statesman Richard Stockton, who had been a student at Elizabethtown and there met and courted Annis Boudinot, the mistress of Morven, who gave it its poetical name.‡ To these should be added Hon. Robert Ogden, Gen. Elias Dayton, and Gov. William Livingston, men prominent in both the colonial and revolutionary history of the State. But the chief figure then upon the stage was his special friend Jonathan Belcher, a graduate of Harvard and a prosperous merchant in Boston, who had been received with special favor by Sophia Dorothea, mother of George II., and appointed Governor of the colonies of Massachusetts and New Hamp-



also much indebted to Ernest L. Myer, Esq., City Surveyor of Elizabeth, for accurate information concerning the estate and residence of Samuel Woodruff, and especially for the engraving of his autograph, which accompanies this sketch.

* Analytical Index of Colonial Documents in the State Paper Office at London. Edited by Whitehead.

† Peartree Smith and Rev. Benjamin Woodruff married sisters of Capt. Bryant, of Amboy, a family of great refinement. Judge Elisha Boudinot, brother of Elias, married into the same family. Both Peartree Smith and Elias Boudinot were near neighbors of Samuel Woodruff, lived in houses which he had sold or let to them, and were appointed guardians of his grandchildren by the will of his son Joseph Woodruff.

‡ This manorial estate originated in a grant from William Penn of five thousand and five hundred acres, embracing the present grounds of the College and village of Princeton. The name of Morven was taken from the scene of Ossian's poems, which were much admired and discussed in the literary circles of the last century. It signifies a *ridge of hills*, and was applied to a region of wild and varied beauty on the northwest coast of Scotland.

shire, but being driven from office by popular intolerance, was then vindicated at Court and re-appointed to the vacant chair of New Jersey. Perhaps it was not strange that his New England friends would not have a governor over them who wanted a fixed salary for the office, while he chose to set up his own "coach-and-four" and thoughtlessly remarked that he "drank half a bottle of old Madeira a day," besides indulging a "taste for malt drink." The gentlefolk of Elizabethtown seem to have had less difficulty in reconciling his "elegant style of living" with Christian virtues when they found that he had driven that coach-and-four twenty miles to hear Tennent preach and placed Brainerd and Whitefield as honored guests at that sumptuous table. They may even have forgiven him the Madeira and the Malmsey after they learned what Whitefield wrote back to Lady Huntingdon, the patroness of their young college:

"I am staying at Governor Belcher's, who sends your ladyship his cordial respects. His outward man decays, but the inward man is renewed day by day. I think he ripens for heaven apace. Last week was the Commencement of the New Jersey College, at which the President and Trustees were pleased to present me with the degree of A.M."*

It was a state of society which has been quite effaced and hidden from the view of our more democratic times. Between the extremes of Northern and Southern culture, it laid stress upon forms and titles and costumes, while insisting upon the claims of virtue and piety. There was in it a touch of English gentility over the harshness of the Puritan, the strictness of the Covenanter, the staidness of the Hollander, the primness of the Quaker, the grace of the Huguenot, and the gaiety of the Cavalier. At one time, indeed, all these elements seem to have been fused together under the eloquence of that Presbyterian clergyman of the Church of England, George Whitefield, who was then traversing the colonies like another apostle to the Gentiles. The Rev. Mr. Chandler, Missionary to the little flock of St. John, wrote home to the London Society in disgust, that schism was becoming a mere "ecclesiastical scare-crow," churchmen and dissenters being so mixed up together that they would not discriminate between "Episcopal and y^e^ leathern mitten ordination," which his neighbor, the Rev. Jonathan Dickinson, had been defending in sundry learned essays.† The preceding rector, good old Mr. Vaughn, had died on the same day with Dickinson, exclaiming, when told that his friend was also dying, "Oh, that I had hold of the skirts of brother Jonathan!" So little after all had they been divided at heart. The type of breeding which prevailed may be suggested to us by the quaint picture of Mr. Woodruff's own son, a graduate of the College, the Rev. Benjamin Woodruff, of Westfield, who is described as "dignified and precise in his manners, social in his habits, scrupulously exact in his dress, with small clothes, silk hose, silver buckles, cock-hat and ruffles; everywhere the same and always commanding profound respect."‡ But the portrait would not be complete without the moral lineaments afforded by his epitaph as it may be read in the aisle beneath his pulpit:

The Dust lies Here
Of a Venerable Man
Formed from early youth
In Learning human and divine;
Passed his Collegiate studies with reputation;
Soon entered the Holy Ministry;
Was settled nearly forty years
Pastor of this Church.
An excellent preacher,
Zealous, pathetic, prudent and successful.
In controversy moderate and calm.
Among ministers, husbands, fathers, brothers, friends,
Few his equals.
Piety, hospitality, friendship,
Humility, benevolence and modesty,
Formed his character.

* Life and Times of Whitefield, II, 255.

† Sprague's Annals, V, 138.

‡ Dr. Samuel D. Alexander's Princeton College in the 18th Century.

Amid such influences the College had been projected when Mr. Samuel Woodruff took part in its organization. He had seen its first class of six students trained by his pastor, had entered two of his sons in its next class, and had been called to a seat in its board of trustees at the first meeting under the charter. He brought to it abilities already tested in positions of trust and influence. His wisdom, forethought and energy seem to have been at once enlisted in its service. As to the important question of its future location, he represented the chief town of the province, and probably the negotiations, as appointed by the trustees, were held in his own house at Elizabethtown with the young pastor and trustee, Elihu Spencer, among his guests. In committee with President Burr of Newark, Caleb Smith of Orange, and Sergeant, who had lately "viewed the promised land at Princetown," he discussed the advantages of that place, which was then an unpretending little hamlet, but central to the Jerseys, on the post-road midway between the growing towns of Philadelphia and New York. From two public spirited gentlemen of that neighborhood, Judge John Stockton, father of the Signer, and Judge Thomas Leonard, one of the Trustees, he took the required bond for one thousand pounds, which made Princeton the seat of the future college; and from Nathaniel Fitz Randolf, ancestor of Gov. Randolf, he received the deed of the ground which was to form its campus. A few months later, in conference with the architect, Robert Smith, father of President Stanhope Smith, he studied the plans of a college building which would be the largest edifice on the Continent. These preliminaries having been arranged, at length, on the 29th of July, 1754, he stood with the little group of trustees, patrons, villagers and workmen, gathered to lay the corner-stone of Nassau Hall. From that time forward, as already indicated, his services were rendered during a period of nearly twenty years, embracing the administrations of Presidents Burr, Edwards, Davies and Finley, and characterized by great disappointments and struggles as well as successes. Many an informal consultation he must have had with his co-trustees and neighbors above named, who were then the ruling minds in the Board, and especially with Gov. Belcher, who was fond of styling the infant college his "adopted daughter" which he hoped to endow as a true *alma mater* of learning and piety. As executor of the Governor's will he at length had the duty of transmitting a bequest of valuable books which were the foundation of its library. At the time of his own decease, the College was attracting students from all the colonies and already had a European reputation through the writings of Edwards and the eloquence of Davies. He lived just long enough to hear that Witherspoon was coming to open before it a new era of growth and renown.

During all this portion of his life his public spirit had also been shown in the civil affairs of the province. Named in the charter for the borough of Elizabethtown in 1739, he was one of its first aldermen and its mayor from 1751 until 1759, and perhaps for a longer period. He seems to have held various judicial positions. When the seat of the colonial government was removed from Burlington to Elizabethtown, Mayor Woodruff corresponded with Governor Belcher, made arrangements for his official residence and public reception after the formal manner of the times, and began those close personal relations with him which were maintained until the end of his life. To this friendship he may have largely owed his elevation to a seat in the Royal Council. His claims for that position were thus set forth by the governor in

an official letter* to the English Ministry:

Elizabethtown, Nov. 19, 1756.

My Lords:

I am now to inform your Lordships that a few months ago died John Rodman, Esq, late of His Majesty's Council of this Province, and I would now in obedience to His Majesty's 6th Royal Instruction, nominate to your Lordships Samuel Woodruff, Esq, for filling up this vacancy, and I do with all freedom recommend him to your Lordships, as a Gentleman of strict Virtue, of good Ability, and of a good Estate; He is and has been for several years Mayor of this Town and one of the Judges of the County Court; of great Loyalty and Zeal for advancing His Majestys Interest and Honour at all times; nor do I know a more worthy Person to supply the said Place.

Mr. Woodruff writes Mr. Partridge [in London] to wait on Your Lordships on this Occasion, and I have the honour to be with great Respect and Deference, My Lords,

Your Lordships most obedient
and most humble servant.
J. Belcher.

The King's mandamus to admit him to the Council was received July 25, 1757; he was re-appointed in 1761; and continued in office until his death in 1768. The colonies were then entering into the ferment which led to the rupture with the mother country. What his political course would have been had he lived longer, can only be conjectured. It might not be just to him to speculate as to the opinions of one who was so loyal to his king and who died before such loyalty ceased to be a virtue. By declining to attend a special meeting of the Council called to approve the odious measure known as the Stamp Act, he may have shown the spirit which afterwards became revolutionary. But a pronounced policy of this sort could only be pursued by his successor in office. On the occasion of his decease Governor Franklin addressed the following letter† to the Earl of Hillsborough, Secretary of State for the Colonies:

Burlington, Aug. 13, 1768.

My Lord:

I am just informed that Mr. Woodruff, one of His Majesty's Council for New Jersey, died on Wednesday the 10th inst: I therefore take the liberty to recommend Richard Stockton, Esq, of Princeton, to succeed Mr. Woodruff in the Council. He is a Gentleman of Fortune. Character and Ability, every way qualified to serve His Majesty in that Capacity; and, if I am not misinformed, had the honour to be known to your Lordship when he was lately in England.

I am, with the greatest respect,
Your Lordship's most obedient
and most humble servant,
Wm. Franklin.

The Richard Stockton here named afterwards became distinguished as a signer of the Declaration of Independence. During the visit alluded to he had acted for the College as clerk of the trustees in securing the acceptance of the presidency by Dr. Witherspoon and had presented to the King on behalf of the Provincial Council an address of thanks for the repeal of the Stamp Act. His appointment now follows as a matter of course. "At the Court of St. James, November 2, 1768," so runs the next official record, "His Majesty is pleased to order that the said Richard Stockton, Esq., be constituted and appointed a member of His Majesty's said Council in the room of the said Samuel Woodruff, Esq., deceased."‡

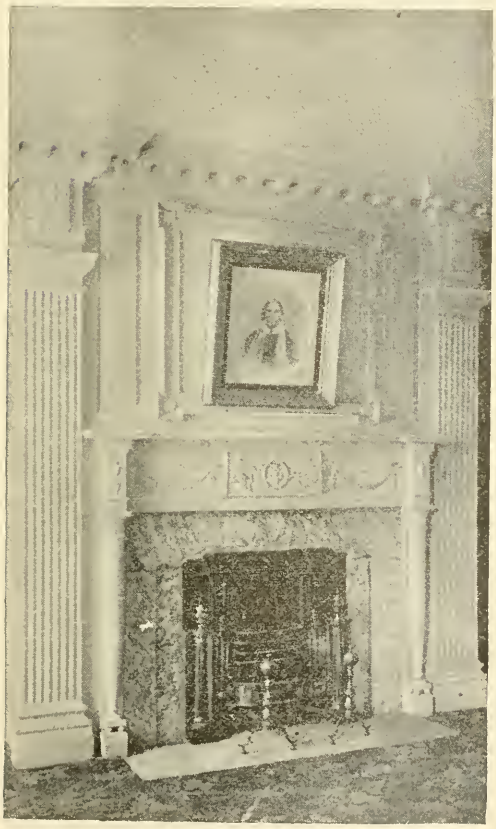
Mr. Woodruff left a large estate, comprising several plantations and town houses occupied by his children. His own residence, "Boxwood Hall," was purchased of his heirs by Dr. Elias Boudinot;‖ and has since been known as the Boudinot house,

* Archives of N. J., Vol. IX.
† Archives of N. J., Vol. X.

‡ It is a coincidence, which may interest some persons, that, after the lapse of one hundred and twenty-three years, branches of these two families, as connected by marriage, have come into possession of the Morven mansion, at a juncture when otherwise that family seat would have passed out of a succession in which it has been maintained for two centuries.

‖ Hatfield's Elizabethtown, p. 588. Deeds and Mortgages, Essex Co., Book A, 1763, 1769, 1773, 1774. The place is described (1769) as land "where Joseph Woodruff now lives, and on which Hon. Samuel Woodruff, deceased, lately lived."

where General Washington with a distinguished company was entertained on his way to New York to be inaugurated first President of the United States. The historic banquet was repeated in its dining-room at the recent Centennial, by Governor and Mrs. Green, with President and Mrs. Harrison as the guests. Of this old colonial relic the accomplished historian, Mrs. Martha J. Lamb, writes as follows: "It was a great, square, comfortable structure, with an old-fashioned gable-roof, tall chimneys suggestive of forefatherly fire-places, and a massive door with a brass knocker in the centre of a somewhat imposing front. It stood among lawns and gardens and lofty trees, very much embowered and hidden in summer-time, with aspiring vines, attractive shrubbery and gay-colored flowers. There was no Jersey Street then, but the house was reached by a private carriage-way from the old road to Elizabethport. Its entrance hall and stair-case are of the style so much in fashion before the Revolution, the former being broad enough for a cotillion party. Two stately apartments on either side of this central hall reveal even at this late day many traces of former elegance and taste. The mantels with their quaint carving and the curious cornices are worthy of note. Two stories have been added to the building, which has been converted into a Home for Aged Women, but the charm of its historic associations remains."



MANTEL PIECE AND WAINSCOT IN DRAWING-ROOM AT BOXWOOD HALL.

There is much circumstantial evidence to connect this ancient mansion with the early fortunes of the College as well as with patriotic memories of later date. The prominence assigned to Mr. Woodruff as second only to the President in the Committee of Negotiation; the legal and business nature of the transaction; his varied qualifications for it as a successful merchant, mayor, judge, and king's councillor; the appointment of the meeting at his place of residence, distant from a majority of the committee; the natural choice of his house so well known as a seat of generous hospitality, and the improbability of anyother choice,—all conspire to suggest that in Boxwood Hall were signed the documents which secured the foundation of Nassau Hall at Princeton.

CHARLES W. SHIELDS.

SUMMARIES OF PAPERS PUBLISHED.

A METHOD FOR SEPARATING SULPHARSENIC ACID FROM SULPHOXYARSENIC ACID.*

By L. W. McCAY.

In studying the reactions which take place when the pentasulphide of arsenic is acted on by the alkali hydrates † I have been compelled to work out a method for separating sulpharsenic acid from sulphoxyarsenic acid. The method is based upon the following facts:

1. When the solution of a sulpharseniate of an alkali is made moderately acid with sulphuric or hydrochloric acid the salt is decomposed instantaneously, and sulpharsenic acid precipitated:

$$2(Na_3\ As\ S_4) + 3(H_2\ S\ O_4) = 3(Na_2\ S\ O_4) + 2(H_3\ As\ S_4).$$

The sulpharsenic acid, however, being very unstable, splits up gradually into sulpharsenic anhydride and sulphuretted hydrogen:

$$2(H_3\ As\ S_4) = As_2\ S_5 + 3(H_2\ S).$$

This tendency of the sulpharsenic acid to decompose can be in a great measure checked by keeping the solution in which it is suspended surrounded by a freezing mixture.

2. When a very dilute solution of a sulphoxyarseniate of an alkali is cooled in a freezing mixture and made distinctly acid with hydrochloric or sulphuric acid, the salt is decomposed and the sulphoxy acid liberated. In these circumstances, however, it does not split up into arsenious acid and free sulphur ‡ but remains perfectly intact. The ice-cold solution will remain clear for hours, and even small quantities of sulphuretted hydrogen fail to bring about any appreciable change. To separate then the two acids it is only necessary to see that the solution of them is very dilute($500\,cm.^3\ H_2O : 0.1250\,g.\ As_2O_3.S_2$) and at a temperature corresponding to that of melting ice. The filtering should be done as rapidly as possible, on account of the gradual decomposition of the sulpharsenic acid into the pentasulphide and sulphuretted hydrogen, and for this purpose the use of the Bunsen pump is strongly recommended. The salts used were: Bouquet and Cloez's potassium sulphoxyarseniate ($H_2\ K\ As\ O_3.S$), of an exceptional degree of purity, and a sodium sulpharseniate which gave on analysis 38.01 instead of 38.08 per cent. $As_2\ S_5$. In obtaining the results given below I proceeded exactly as follows:

The sulphoxy salt and sulpho salt were dissolved in 500 cm.³ ice-cold water, and the solution was then made moderately acid with dilute sulphuric acid. The flask containing the solution was placed in a freezing mixture of ice, salt and water, and a rapid current of filtered air was sucked through the liquid for about fifteen to twenty minutes. After the current of air had been stopped, and the mixture of sulpharsenic acid and pentasulphide of arsenic had settled, the clear, supernatant liquid was poured off and filtered through a Gooch crucible, and the precipitate brought into the crucible and washed thoroughly, first with water and then with alcohol. The precipitate was dried to constant weight at 110° C., and then extracted (II. and III.) five or six times with bisulphide of carbon and washed with absolute alcohol. This was done in order to remove 1—2 milligrammes of

* Orthomonosulphtrioxyarsenic Acid.

† Preliminary Notice—*Chemiker-Zeitung*, 1891, XV, 476.

‡ *Zeitschrift f. analyt. Chemie*, XXVII, pp. 632-634.

sulphur which almost always remain with the sulpharsenic anhydride (I.), owing to a decomposition of some sulphuretted hydrogen which fails to escape in the drying, but splits up under the influence of the air into water and free sulphur. The cold, clear filtrate which invariably smelt faintly of sulphuretted hydrogen was saturated with chlorine gas, evaporated to small bulk and brought into a little bottle holding 200 cm³. The bottle was filled almost full of freshly boiled water, the solution saturated with sulphuretted hydrogen gas, the bottle tightly stoppered and the whole put in a boiling water bath for an hour.*

The pentasulphide was washed first with water and, in order to replace this and extract traces of sulphur, with absolute alcohol, and weighed in a Gooch crucible. Temperature of drying 110° C.

I.

TAKEN.

0.1300 g. $2(Na_3\,As\,S_4)\,.\,15\,H_2O = 0.0495$ g. As_2S_5.
0.1800 g. $H_2\,K\,As\,O_3\,.\,S = 0.1423$ g. $As_2\,S_5 = 0.1202$ g. $As_2\,O_3\,.\,S_2$.

FOUND.

0.0516 g. $As_2\,S_5$.†
0.1405 g. $As_2\,S_5 = 0.1188$ g. $As_2\,O_3\,.\,S_2$.
0.0516 — 0.0495 = 0.0021 g. $As_2\,S_5$ too much.
0.1201 — 0.1188 = 0.0013 g. $As_2\,O_3\,.\,S_2$ too little.

II.

TAKEN.

0.1284 g. $2(Na_3\,As\,S_4)\,.\,15\,H_2O = 0.0488$ g. As_2S_5.
0.1896 g. $H_2\,K\,As\,O_3\,.\,S = 0.1499$ g. $As_2\,S_5 = 0.1266$ g. $As_2\,O_3\,.\,S_2$.

FOUND.

0.0485 g. $As_2\,S_5$.
0.1490 g. $As_2\,S_5 = 0.1260$ g. $As_2\,O_3\,.\,S_2$.
0.0488 — 0.0485 = 0.0003 g. $As_2\,S_5$ too little.
0.1266 — 0.1260 = 0.0006 g. $As_2\,O_3\,.\,S_2$ too little.

III.

TAKEN.

0.1303 g. $2(Na_3\,As\,S_4).15\,H_2O = 0.0496$ g. As_2S_5.
0.1854 g. $H_2\,K\,As\,O_3\,.\,S = 0.1466$ g. $As_2\,S_5 = 0.1238$ g. $As_2\,O_3\,.\,S_2$.

FOUND.

0.0496 g. $As_2\,S_5$.
0.1447 g. $As_2\,S_5 = 0.1223$ g. $As_2\,O_3\,.\,S_2$.
0.0496 — 0.0496 = no difference.
0.1238 — 0.1223 = 0.0015 g. $As_2\,O_3\,.\,S_2$ too little.

Since sulphoxyarsenic acid is an extremely unstable compound the above method will, I think, be regarded as quite satisfactory.—Written for *Fresenius's Zeitschrift.*

* Not washed with bisulphide of carbon after first drying.

† *American Chemical Journal*, IX, No. 3.

ON SOME OF THE FACTORS IN THE EVOLUTION OF THE MAMMALIA.

By W. B. SCOTT.

The question of evolutionary philosophy as to which there is at present the most dispute, is undoubtedly that with regard to the causes of variation, together with the problems of heredity which are inseparably connected with it. The brilliant essays of Weismann have done great service in calling renewed attention to these fundamental questions, for there can be no doubt that most speculations upon the subject had been taking too much for granted and that the foundations of one essential part of current evolutionary belief were insecurely laid. The whole subject needs therefore to be exhaustively re-examined and tested from every side.

For the purposes of this paper it is not necessary for me to enter into the reasons of my dissent from Weismann's theory of the continuity of the germ-plasm, nor to explain why, in my opinion, so far from rendering the phenomena of heredity more intelligible, it tends to confuse them still further and to end logically in a system very like the old preformationism. As Lloyd Morgan has very pithily put it,

"I cannot but regard Weismann's doctrine of the continuity of germ-plasm as a distinctly retrograde step. His germ-plasm is an unknowable, invisible, hypothetical entity. Material though it be, it is of no more practical value than a mysterious and mythical germinal principle. By a little skillful manipulation it may be made to account for anything and everything. The fundamental assumption that whereas germ-plasm can give rise to body-plasm to any extent, body-plasm can under no circumstances give rise to germ-plasm introduces an unnecessary mystery. Biological science should set its face against such mysteries." But into this subject we need not enter, because so far as the mammals are concerned, the difficulty of comprehending how somatic changes can affect the germ in appropriate fashion so as to reproduce these changes in the offspring, is in no way diminished by a denial or even a complete refutation of the continuity theory. Weismann states the difficulty thus: "It is perfectly right to defer all explanation and to hesitate before we declare a supposed phenomenon impossible, because we are unable to refer it to any of the known forces. No one can believe that we are acquainted with all the forces of nature. But, on the other hand, we must use the greatest caution in dealing with unknown forces, and clear and indubitable facts must be brought forward to prove that the supposed phenomena have a real existence and that their acceptance is unavoidable." But does the assumption that acquired characters are transmissible involve, as a matter of fact, an appeal to unknown forces? Rather, I should say, to the as yet not well understood operation of known forces. In another connection, Weismann has himself well defended this principle, where, in arguing against the idea of a vital force, he says: "The latter [*i. e.* the ontogenetic vital force] is no longer admitted by anybody, now that we have turned from mere speculation to the investigation of Nature's processes; nevertheless its non-existence has not been demonstrated, nor are we yet in a position to prove that all the phenomena of life must be traced to purely physico-chemical processes, to say nothing of our actually being able to so trace them."

In his later papers Weismann admits that the germ-plasm may be modified in various ways. "It must be admitted that there are cases, such as the climatic varieties of certain butterflies, which raise some difficulties against this explanation. I myself, some years ago, experimentally investigated one such case, and even now I cannot explain the facts otherwise than by supposing the passive acquisition of characters, produced by the direct influence of climate." "I am at present inclined to believe that Professor Sims is correct in questioning whether sexual reproduction is the *only* factor which maintains Metazoa and Metaphyta in a state of variability." We have indeed abundant evidence that food, temperature, moisture, salt,—the like may have a profound influence upon the germ-plasm, and though we can form no conception of the way in which the amount of salt in the water will change *Artemia* into *Branchipus*, or the quantity of food will determine the proportions of the sexes in tadpoles, or how the change of food plant metamorphosed the Texan species of *Saturnia* into something very different yet we are not impelled to take refuge in an appeal to unknown forces. Nor can the well-known influence of the germ-glands upon the body be explained in the sense of determining just how and why the effect is produced. If the presence of the germ-glands can so profoundly affect the soma, why should the converse influence appear so incredible? Still more mysterious is the influence exerted upon the maternal

organism by the spermatozoa (or, perhaps, the fœtus,) so that the offspring by later sires often show characters of previous sires. Virchow pronounced the stigmata of Louise Lateau to be "either fraud or miracle," but the recent investigations in hypnotism show that the case may be explained without accepting either horn of the dilemma. Whether acquired characters be transmitted or not, it is certainly inadmissible to speak of such transmission as inconceivable or as involving the operation of unknown forces.

It is extremely difficult to obtain any satisfactory evidence of the transmission of acquired characters, and this for two reasons. In the first place, it is generally well nigh impossible to determine in any given instance whether a character is acquired or congenital (employing the latter term to designate characters due to changes in the germ-plasm itself). As a rule, it is taken for granted that those structural features with which an animal is born or hatched are altogether congenital, but nothing can be more improbable, for we know that embryos are very sensitive to changed conditions and are easily modified, but to determine what characters are due to changes in the ovum and what to modifications in the embryo is a difficult matter. For my own part, I am not inclined to attach much importance to the supposed cases of transmitted mutilations, as from an *à priori* standpoint they are improbable and more especially because the long continued mutilations practiced by many savage races appear to be without result in this respect. Nevertheless such facts as those stated by Eimer and De Candolle, from their own knowledge, and the experiments of Obersteiner upon guinea-pigs, are not to be dismissed with a sneer. Arbuthnot Lane has come to the conclusion "that a force which produces no obvious change in the skeleton of the antecedents, but only a tendency to changes, can, acting as a developmental factor, cause the apparently spontaneous development of that change in the offspring." It is also well worthy of inquiry how far the extraordinary skill and deftness of Japanese and other Oriental workmen is due to the fact that handicrafts have long been hereditary in the same families. Dall's position is an eminently reasonable one: "The contention of Weismann that 'not a single fact hitherto brought forward can be accepted as proof' of the transmission of acquired characters, demands attention. This reminds one of the familiar statement of twenty years ago that the Darwinians had not brought forward a single instance of the conversion of one species into another species. If the Dynamic Evolutionist brings forward an hypothesis which explains the facts of Nature without violence to sound reasoning that hypothesis is entitled to respect and consideration until some better one is proposed or some vitiating error detected in it." When we remember that evolution is a slow process, it is hardly to be expected that dynamic influences should be immediately apparent, though the experiments on *Artemia* and on feeding caterpillars point to a different conclusion. The question must be decided, if at all, by the inductive method, by determining how the observed facts can best be interpreted.

When we turn to the hypothesis which Weismann proposes in place of what Dall calls the dynamic theory, we might naturally require the same rigid demonstration which he demands of his opponents, but of such demonstration we find little, rather ingenious speculation. Although he has abandoned the view that sexual reproduction is the *only* factor in inducing variability, he still appears to maintain that it is by far the most important. "I am still of the opinion that the origin of sexual reproduction depends upon the advantage which it affords to the operation

of natural selection; nay, I am completely convinced that only through its introduction was the higher development of the organic world possible. . . . . Even if, however, from our present knowledge it is probable that sexual reproduction is not the sole radical cause of variability in the Metazoa, still no one will dispute that it is a most effective means of heightening variations and of mingling them in favorable proportions. I believe that the important part which this method of reproduction has played in calling out the existing processes of selection, is hardly diminished, even if one grants that direct influences upon the idioplasm call forth a portion of individual variability." Weismann still maintains that somatogenic characters, the effects of use and disuse, cannot be transmitted and attempts to "elucidate the phenomena without the aid of this principle."

But, as Lloyd Morgan has pointed out, "by sexual admixture alone, there can be no increase or decrease, beyond the mean of the two parental forms. If, then, the union of the sperm and ovum be the source of new or more favorable variations, other than or stronger than those of either parent, this must be due to the fact that the hereditary tendencies not merely commingle, but under favorable conditions combine, in some way different indeed from, but perhaps analogous to, that exemplified in chemical combination." Of course, such organic combination is not vouched for by a particle of evidence. Again, on the theory of heredity propounded by Weismann, such variations are necessarily single, and there is no probability that the same variation will arise twice even in the same litter. Now it has never been shown that such variations can be perpetuated in spite of the swamping effects of free intercrossing, nor that such minimal differences as a slight shifting of the carpal and tarsal elements or the presence of a tiny incipient cusp upon a tooth, can be of decisive effect in the struggle for existence. This difficulty has long been felt and many attempts have been made to meet or to evade it. Weismann has stated the case thus: "Such calculations as those quoted by Darwin from the article in the *North British Review* for March 1867 are extremely deceptive, since we have no means of measuring the amount of protection afforded and we can therefore hardly compute with any certainty in how great a percentage of individuals a change must contemporaneously occur in order to have a chance of becoming transferred to the following generation. . . . . *Variations which occur singly have but little chance of becoming predominant characters* and this is obviously what Darwin concedes, but this is by no means equivalent to the assumption that only those variations which from the first occur in numerous individuals, have a chance of being perpetuated." But it is difficult to see on Weismann's principles how variations can occur other than singly (*i. e.* excluding those cases of the influence of the environment upon the germplasm, by which many individuals are simultaneously affected) except in the direct line in which the changes first appeared, for by hypothesis every fertilized ovum is different in important respects from every other and on the doctrine of chances there is only an infinitesimal probability that it can ever be duplicated. The argument that variations do occur in nature sufficient to give the necessary material for the operation of natural selection, does not touch the real difficulty, which is, what *causes* these variations? It is taking a great deal for granted to assume that they are solely or even mainly to sexual reproduction.

The relatively fixed direction taken by variations, which has been insisted upon by so many observers (*e. g.* Askenasy,

Eimer, Geddes, Thompson and Osborn,) comes out most clearly in the series of fossil mammals. Granting that unlimited variation is no necessary part of the selection theory, it seems strange that new facets on the bones and new cusps on the teeth should appear only in such definite ways and that there should not be many tentative attempts and false starts before the proper development is hit upon. In the structure of the carpus and tarsus we find that in any given phylum very definite lines of evolution are early established and closely adhered to, and the changes are just those called for by the operation of dynamical influences. If Weismann's position were correct, we ought to find much greater latitude of variation.

It is thus difficult to understand how even a single variation can be established by the unaided operation of sexual reproduction and natural selection, but the difficulty is greatly increased when we take into account the phenomena of parallelism and convergence. The selenodont type of molar tooth has been independently acquired in at least three lines and probably in many more. The molariform premolars which occur in so many perissodactyls, in some artiodactyls and in other groups, though copying more or less exactly the pattern of the molars, are composed of parts which are not homologous with those occupying similar positions in the molar crowns. These changes can be followed step by step and accounted for, if we admit the action of mechanical influences, but are very puzzling on the hypothesis of all round variation. The spout-shaped odontoid process of the axis occurs in the camels, the true ruminants, the horses and other groups and it has been shown that this structure is not due to inheritance from a common ancestor, but has been separately acquired. Still more striking is the case cited by Kowalevsky of the sudden and simultaneous appearance (using these terms in their geological sense) in so many different groups of the prismatic or rootless molar, with very complex enamel foldings and the valleys filled with cement. Kowalevsky believes that the occasion of this remarkable revolution, as it may fairly be called, was the great extension of the grassy plains and the consequent change on the part of most herbivorous animals from a diet of soft plants and leaves to the siliceous grasses. Now what is the probability that such a series of changes in horses, rhinoceroses, pigs, ruminants, elephants and other families, should be due primarily to the mingling of different hereditary tendencies, especially when it is remembered that none of the ancestors of these groups possessed any such teeth? Or can it be reasonably contended that such parallel variations are due to the direct action of the climatic or other environment upon the germplasm? The tendency to the formation of prismatic molars appears even in the early Tertiary times, as is seen in *Paloplotherium* and *Hypisodus*, but these were premature attempts and led to nothing. Cope has shown how clearly the skeletal peculiarities of the feet of the Tylopoda may be deduced from the mechanical effects of the cushion or pad upon which the foot rests, and I may add that the steps of the enlargement of this pad may be inferred, in the extinct forms, from the successive changes in the phalanges. The similarities between the elephants on the one hand and *Uintatherium*, on the other, are just those which must accompany greatly increased height and bulk, though the latter is the more important factor.

Furthermore, the facts of pathology and surgery bring clearly before us the way in which the skeleton is moulded by the pressures and strains to which it is subjected. The tendinal sulci are formed by the pressure of the tendons, and if these

tendons are dislocated, the old grooves are gradually filled up and new ones formed. "After dislocations the old articular cavities will be filled up and disappear, while at the new point where the bone is actually placed, a fresh articulation is found, to which nothing will be wanting in the course of a few months, neither articular cartilages, synovial fluid, nor the ligaments which retain the bone in place." (Marey). The arrangement of the trabeculæ in the interior of the bones is in the direction of the line of the greatest pressure and strain, giving great strength with a minimum of material. When, by a fracture and re-union the relation of the bone to the line of strain is changed, the direction of the trabeculæ will be correspondingly altered. The papers of Arbuthnot Lane give an admirable account of the way in which long-continued routine labor will modify the shapes and articulations of the bones. It would, however, be a mistake to suppose that the bone-structure is entirely due to influences exerted in the life-time of the individual, for the facts of development show that these structures appear in the fœtus before such influences are exercised.

The proximal end of the humerus is very similar in the White River representatives of the horses and camels (*Mesohippus* and *Poebrotherium*) having the bicipital groove single, narrow, and placed at the antero-internal angle of the head, while the external tuberosity is very large and extends across nearly the entire anterior face of the bone. In the modern forms the bicipital groove is double, being divided by the large bicipital tubercle, and the external tuberosity is reduced to the size of the internal one. If all these changes, which are carried out in such exact accord with the mechanical exigencies of each case, are not somatogenic how can they be accounted for? What chance is there of such occurrences repeatedly taking place in widely separated groups of animals as the result of sexual reproduction, or of changes in the germ-plasm which stand in no other causal connection with the mechanical needs of the body, than that these variations which happen to be favorable are preserved? The improbability of such an explanation is still further increased by the fact that the numerous non-mechanical variations, which on this theory ought to occur, are not to be found in the fossil series except very rarely, and then as the manifest results of disease or accident. Why should there be such a profound difference between the method in which useful changes are brought about in the individual and those which modify the species? and how can we explain the mysterious pre-established harmony between the two classes of phenomena? It seems very wonderful that an "ever vigilant natural selection," which introduced sexuality for the very purpose of producing and combining variations, should have failed to seize and make use of somatogenic changes.

This class of phenomena is by no means confined to the vertebrate skeleton. Dall has shown how the characters of the hinge and shell of the bivalve mollusks have been evolved in accordance with mechanical principles. He has also shown "how the initiation and development of the columellar plaits in *Voluta*, *Mitra* and other Gasteropods, is the necessary mechanical result of certain comparatively simple physical conditions; and that the variations and peculiarities connected with those plaits perfectly harmonize with the results which follow with inorganic material subjected to analogous stresses." Neumayr, in describing the transition of *Paludina Neumayri* into *P. Hoernesi* says: "Wenn man ein Thonmodell von *Pal. Neumayri* hätte und dasselbe auf die einfachste und kürzeste Weise in *Pal. Hoernesi*

umformen wollte, man könnte es kaum anders machen als die Natur vorgegangen ist." Jackson has reached very similar results in the same department of investigation.

[Abstract of a paper read before the Princeton Biological Club.]

THE STRUCTURE OF INSECT-TRACHEÆ.

By GEORGE MACLOSKIE.

In 1884 I published a short paper to show that the tracheæ of Insects have been usually misunderstood, giving reasons to believe that the spiral thickenings are really spiral convolutions, like the wrinkles in the sleeve of a coat, that they are channel-like folds open outwards by a slit or fissure.

This view was reached as an inference from my own examination of the pseudo-tracheæ of the Horse-fly, and from Kraepelin's examination of the teeth of the Blow-fly; and I found confirmation of it in certain markings on the tracheæ. Such evidence, however, being of an indirect character, has not satisfied others; and Miall and Denny in their Monograph on the Cockroach after criticizing my work reproduce Chun's figure which erroneously represents the Insect-tracheæ as having a long free spiral thread like vegetable tracheæ.

This criticism has compelled me to re-examine the subject, with the curious result that not only does my view prove to be the correct one, but that after all the work and the multitudes of papers issued on this theme, it can be easily observed with the microscope. The hypodermis surrounding the tracheæ sometimes obscures their profile at the edge; but it is usually possible to observe in a medium-sized branch, especially when slightly stretched under the cover-glass, that the spirals are folds of the chitine-wall, grooved on the outside, the channels showing in profile along the edge, like the thread of a screw. Not only have I seen this in many fresh specimens, but in an old mounted specimen of the internal parts of a Fly it is plainly visible. It is singular that so obvious a character has hitherto escaped notice. Prof. H. T. Fernald informs me that by means of sections he has confirmed this view.

Dec. 29, 1891.

[Abstract of paper read before the American Society of Naturalists.]

GRAPHICAL SCIENCE—PAST AND PRESENT.

By FREDERICK N. WILLSON.

In view of the accepted division of mathematical properties into *metrical* and *descriptive* and of the more general sense in which the title *Descriptive Geometry* (*darstellende Geometrie, Géométrie Descriptive*) is now used abroad, the following was presented as a definition therefor: "Descriptive Geometry is the science in which figures are represented and their descriptive properties investigated and demonstrated by means of projection."

Its sub-divisions were then indicated as follows:—

(a) *Projective Geometry* (*Geometry of Position*).

(b) *Perspective.*

(c) *Relief-Perspective.*

(d) *Shadows* (*artificial light*).

(e) *Photometrography.*

UNDER PARALLEL PROJECTION.

Oblique or *Clinographic Projection*, otherwise *Cavalier Perspective* (plane vertical) or *Military Perspective* (plane horizontal). *Shadows.*

PERPENDICULAR OR ORTHOGRAPHIC PROJECTION.

Special names when but one plane of projection is employed:—

(a) *One-Plane Descriptive*, otherwise *Horizontal Projection;*

(b) *Axonometric* (including *Isometric*) *Projection.*

When on two (or more) mutually perpendicular planes the title *Monge's Descriptive* is suggested, that as in the case of Cartesian geometry the name of the inventor may be perpetually associated with his creation and also in view of the more extended significance of the title "Descriptive Geometry."

After considering the characteristics and applications of the foregoing sciences their early history was traced; particular mention and demonstration made of the principles and development of Relief-Perspective; and the present place of the various divisions of Graphics in the curricula of Foreign and American technical schools compared.

[Abstract of paper presented before the Princeton Science Club, December 10th, 1891.]

JAMES RUSSELL LOWELL, AS A PROSE WRITER.

By T. W. HUNT.

After briefly sketching Mr. Lowell's life and personal character and enumerating his various writings, the special topic was taken up and the leading qualities of Mr. Lowell's Prose were discussed.

These were said to be, Clearness, Directness, Ease and Taste and Classical Finish, and, as most important, Mental Vitality. Particular attention was called to Mr. Lowell's English; to his love of Old English books and authors; to his brilliant work as a literary critic; to the cheerfulness and wholesomeness of his Prose, and to the preëminently literary type of his personality and writings. Current objections to his critical methods and spirit were answered, while the paper, at its close, emphasized the fact of the great loss which English Letters had sustained in Mr. Lowell's death.

[Read at Washington, Dec. 29, 1891, before The Modern Language Association of America.]

NOTES.

THE AMERICAN SOCIETY OF NATURALISTS.

At the meeting of this Society held in Philadelphia on Dec. 30, 1891, several professors from Princeton were present and took part in the proceedings. The proceedings of the meetings fell naturally into two parts, first, a discussion on Definite versus Fortuitous Variation, and second, reports of scientific expeditions.

The discussion of variation was opened with a paper from Professor Meehan, who considered the question from the botanical standpoint. Professor McMurrich, Professor Allen and Professor Cope then followed, discussing the subject in connection with invertebrate zoology, vertebrate zoology and palæontology respectively. In the discussion which followed the reading of these papers, Professors Macloskie, Osborn and Libbey took part.

One of the expeditions reported on was that of Professor Baur to the Galapagos Islands He described the peculiarities of those islands and of their fauna, and gave an account of his collections. A part of these collections will come to the Princeton museums.

Professor Libbey gave an account of his measurements of ocean temperatures near the Gulf Stream, and added considerably to what has before been published about this work. After giving an account of his methods of observation, he proceeded to show that there were two different sets of currents, one a deep series and the other a surface set, both being modified by the mechanical laws of their motion, by changes in velocity, temperature and density. But the surface currents were further modified by the direction, duration and velocity of the wind currents.

The appearance of smaller band-like currents upon the north-bound Gulf Stream, which were reversed in the direction of their motion after they had passed somewhat to the northward, was explained and offered as a reason for the appearance of schools of fish at different points of the coast, since the warmer waters provide the proper conditions for the growth and distribution of the fishes' food by the bridging over of the cold current.

The effect of the winds on the modification of the northern boundary of the Gulf Stream was pointed out, and it was shown that it was moving towards the shore off the New England coast. The pilot charts of the North Atlantic coast, in which were given the direction and velocities for the last three years, were quoted in support of this view. Further the influence of these changes in the conditions of temperature and moisture upon our climate were pointed out and some explanations offered.

At the meeting of the Morphological Society held immediately before the meeting of the Society of Naturalists, papers were read by Professor Macloskie, Professor Osborn and Dr. McClure.

THE PRINCETON ALUMNI UNIVERSITY FUND.

It is a matter of great gratification that the Alumni of Princeton are now being organized in an effort to raise by subscription a substantial University Fund. The needs of a growing institution are always in excess of its existing revenues and the fact that the rich endowments of the Old World are not yet distantly approached by any American University lends additional urgency to the appeal now issued by a committee of the Alumni recently appointed by President Patton.

If Princeton is to advance to the position of leadership which her authorities and alumni so earnestly desire, there should be large additions to her endowment,—larger proportionally than even the munificent sums received in the last two decades. Every additional building (except dormitories) makes additional charge on the institution unless the building be supplemented with endowment for its care, insurance and repair. Every additional student, even when paying all his college bills, needs endowment. It has been shown that for every thousand dollars of revenue in the budget of our larger institutions only about three to five hundred at most come from the students, and consequently any great increase of students calls for a corresponding increase in endowments of necessity, if the equipments of education are to be maintained in effective influence on the education of the students themselves. There is a natural limit to what can be done with an existing "plant" and that limit has now been passed here. Our student increase in the last six years is over ninety-six per cent., but our endowments have not kept pace with this phenomenal student growth.

Princeton urgently needs half a million of dollars for her general fund at once, to meet immediately pressing wants.

Then if we look to a great growth toward a strong university life, there should be round millions of dollars for additional professorships, university fellowships of research, for the extension of the library, for

the general strengthening of the college course, and for all that goes to equip and secure a University in the future.

The revenues of Oxford and Cambridge represent a capital of about seventy-five millions of dollars. The University of Leipsic is worth nearer twenty than fifteen millions. Let us measure our effort by such endowments, however far American institutions fall short of them at present.

The effort of the alumni is well conceived and in good hands. If there can be added from year to year such a sum as they propose, the improvement of Princeton will be greatly accelerated, and the way will be cleared for a still greater future advance. It is to be hoped that a general response in the way of subscriptions will be the prompt result of this appeal, and that Princeton and her alumni will be more closely identified than ever before.

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Professor Armstrong of Wesleyan University, a graduate of the Class of 1881 in Princeton, has in preparation a translation of Falckenberg's *Geschichte der neuern Philosophie*, to be published by Messrs. Holt & Co. of New York. Prof. Falckenberg was formerly Privat-Docent at Jena, and is now Professor Extraordinarius at Erlangen. He has previously published on the Kantian doctrine of the Will, and on the system of Nicholas of Cusa. The merits of his Compend of Modern Opinion for American Students are, (1) its comprehensive character; (2) the author's skill in objective exposition, without intrusion of his personal views; (3) his appreciation of English philosophy and thorough acquaintance with it; (4) his discussion of 19th century philosophy down to the present time. It is believed that the English translation will meet the need now widely felt for a treatise intermediate between the exhaustive works of Ueberweg and Erdmann, and such sketches as that of Bowen. The translation will be made with Professor Falckenberg's cordial consent and coöperation.

Since the last issue of the BULLETIN the following appointments have been made: Henry Dallas Thompson, D.Sc., Princeton, Assistant Professor of Mathematics. Marion Mills Miller, Litt.D., Princeton, Assistant Professor of Oratory and Æsthetic Criticism. George McLean Harper, A.B., Assistant Professor of French. Rev. John Grier Hibben, A.M., Instructor in Logic. Charles Sidney Smith, A.M., Instructor in Latin. Charles F. Williams McClure, A.B., Instructor in Biology. Nicholas Everton Crosby, A.M., Instuctor in Greek and Latin. F. Neher, A.M., Assistant in Chemistry. Barton Cruikshank, Instructor in Graphics.

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